Original Article

Utility of a web-based weight loss program with auto-extraction of behavioural objectives and recording of daily weight and steps in pre-obese outpatients

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The epidemic of obesity is now a major public health concern in many parts of the world. Face-to-face tailored lifestyle modification therapy is one of the major approaches used for weight loss. However, the lack of time for multiple visits and the lack of resources for administering therapy hinder its implementation. We administered a web-based weight loss program for obese patients from July 2010 to January 2012 that required only 2 personal interviews over 6 months. The program used a system of auto-extraction of behavioural objectives and auto-recording of daily weight and number of steps taken. The subjects included 3 obese men (mean age, 35.7±2.3 years; mean body mass index (BMI), 30.4±0.8 kg/m^2) and 17 obese women (mean age, 39.3±9.5 years; mean BMI, 28.1±1.8 kg/m^2) who volunteered to participate in this weight loss program. Weight loss achieved through this program was significant (mean, 2.7%, p=0.047). Abdominal visceral fat area (VFA) decreased significantly (mean, 12.6%, p=0.017), and the serum cholinesterase and alanine aminotransferase levels improved (mean, 33 U/L, p=0.003; mean, 7 IU/L, p=0.033 respectively). Metabolic syndrome criteria number had a tendency to decrease. Dietary and nutrient intake levels on the food frequency questionnaire improved. Weight loss ratio after 6 months and initial weight loss ratio were strongly significantly correlated. A web-based weight loss program with auto-extraction of behavioural objectives and recording of daily weight and steps can achieve weight loss, as determined by VFA reduction, on low manpower.

Key Words: web-based, weight loss, weight loss program, visceral fat area, obese

INTRODUCTION

The epidemic of obesity is now a major public health concern in many parts of the world. The number of overweight people is increasing globally, and more than one billion adults have a body mass index (BMI) greater than 25 kg/m^2.[1] In Japan, 30.4% of men and 21.1% of women have a BMI greater than 25 kg/m^2.[2]

Obesity is associated with the development of diabetes,[3] heart disease[4] and stroke.[5] Genetics play a part in determining an individual's propensity to gain weight.[6] Because of their ethnic characteristics, Japanese are especially susceptible to obesity-related diseases, even in the WHO-defined pre-obese state (25≤BMI<30). Therefore, maintenance of a healthy weight is thought to be of greater concern for Japanese than for Europeans and Americans.

In an effort to prevent lifestyle-related diseases, especially metabolic syndrome based on visceral fat accumulation, the Japanese Ministry of Health, Labour and Welfare has been providing specific health check-up and counseling guidance since 2008 in Japan.

Face-to-face tailored lifestyle modification therapy is one of the major approaches used for weight loss. However, lack of time for multiple visits and the lack of resources for administering the therapy hinder its implementation.[7] Remotely managed weight loss programs using information technology (IT) may help to overcome some of these barriers. There are reports showing that weight loss programs using IT can achieve weight loss. In a meta-analysis of the effects of web-based lifestyle modifications on weight control, Kodama et al showed that using the internet as an adjunct to obesity care was effective.[8] However, they also revealed that IT systems were

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ineffective when used as a substitute for face-to-face support, and conversely, can cause weight gain. This may indicate that IT-only weight loss programs have limited utility for weight loss.

We have developed a new lifestyle modification IT system, called "Health Up Web." This system enables easy extraction of lifestyle data and facilitates support for achieving behavioural objectives in weight loss. We subsequently developed a device that enables daily auto-recording of a subject's weight and number of steps taken onto the IT system. We have administered this weight loss program using this system and automatic record device, primarily to pre-obese patients, at the Health Science Centre of our University Hospital. The level of face-to-face support offered was considered to be the minimum required, given the results described above suggesting that use of an IT system alone may have an adverse effect.

MATERIALS AND METHODS

Study subjects

In total, 3 men and 17 women, most of whom fulfilled the criteria for being pre-obese and wanted to participate in an outpatient web-based weight loss program, were recruited into this study. Patients' characteristics at baseline are shown in Table 1. Eighty-five percent of the patients were women, which is equal to that reported in the meta-analysis of web-based weight loss programs.[8]

This study was conducted from July 2010 to January 2012 and all of the patients or their guardians provided written informed consent, and Ethical Committee of Kansai Medical University approved all aspect of this study in accordance with Helsinki Declaration.

Table 1. Patients' characteristics at baseline

	Men	Women
n (%)	3 (15)	17 (85)
Age (years)	35.7±2.3	39.3±9.5
Height (cm)	167±3.8	159±6.3
Body weight (kg)	84.6±1.6	71.3±6.8
BMI (kg/m^2)	30.4±0.8	28.1±1.8
Current smoker (%)	0/17 (0)	
Habitual drinker (%)	7/17 (41.2)	

Data are expressed as mean±SD or as number of patients. There were 3 non responders on current smoker, Habitual drinker. BMI: body mass index.

Health Up Web system

The Health Up Web system (HWS) is a tool to provide specific counselling guidance. The system was developed by Best Life Promotion (BLP Co, Ltd, Osaka, Japan) under the editorial supervision of Yutaka Kimura (a physician at Kansai Medical University Hirakata Hospital). HWS consists of a lifestyle habit questionnaire, a personality trait questionnaire, and behaviour goal setting screen. In the behaviour goal setting, problems in lifestyle habits of individuals are extracted first based on the results of the lifestyle habits questionnaire; it is designed in such a way to select behaviors that correspond to the problems and can be performed by individuals based on the cognitive behavior therapy and health education theory, in line with the stage theory for the improvement of lifestyle habits of individuals. The method for selecting behavioural objectives is shown below. To determine lifestyle problems, subjects completed a 40-item self-administered questionnaire on their lifestyle. The possible responses to each question were as follows: 1 (strongly agree), 2 (agree), 3 (disagree), and 4 (strongly disagree). From the results of the questionnaire, approximately 20 behavioural objectives applicable for the improvement of the patient's lifestyle were extracted randomly. Patients evaluated their self-efficacy for each objective and the degree to which they felt identity with each behavioural objective. Patients responded with either "I can" or "I can't" for the self-efficacy evaluation, and "want to change" or "status quo" for the identity evaluation. Each behavioural objective was then mapped into 1 of 4 categories on a graph as big, medium, or small circles where the Y-axis indicated self-efficacy and the X-axis indicated identity. The 4 categories were determined in the following manner: Category 1 (self-efficacy, I can; identity, want to change), Category 2 (self-efficacy, I can; identity, status quo), Category 3 (self-efficacy, I can't; identity, want to change), and Category 4 (self-efficacy, I can't; identity, status quo). Each behavioural objective was assigned a magnitude (represented by the size of the corresponding circle on the

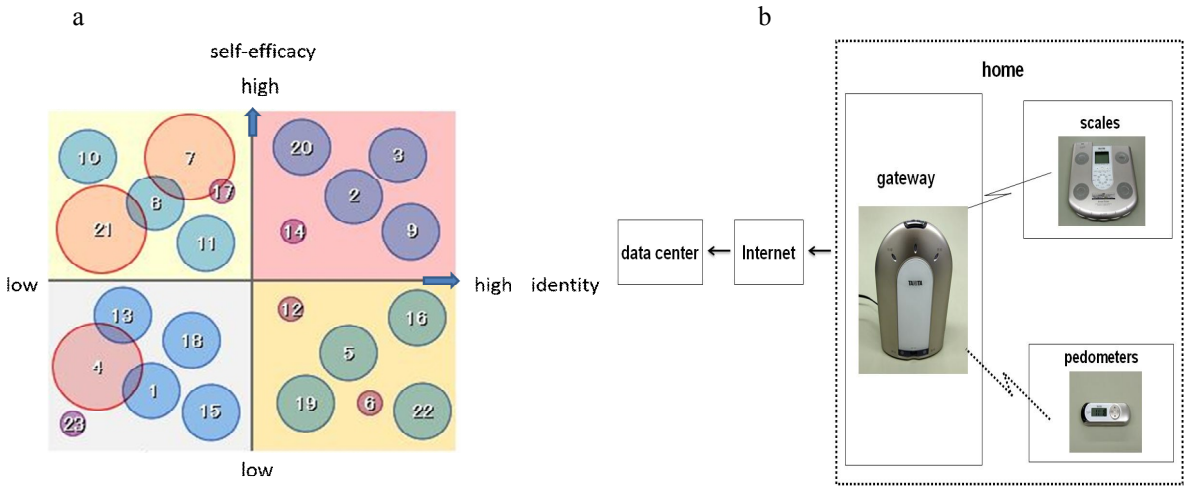

Figure 1. IT systems scheme

graph) to indicate the effect of that behaviour on weight loss (Figure 1a). This process allowed patients to choose behavioural objectives that they believed that they could achieve and that they wanted to change. The attainment of each behavioural objective was evaluated by each patient every day using the scale of 1 (could), 2 (could do a little), and 3 (could not do). The status of each objective was confirmed by medical staff. At the time of initial interview, users used the system and set behavioural objectives. At the initial interview, medical staff explained to the users that working on behavioural objectives that are highly important and they have confidence toward improvement would lead to effective weight loss. After listening to the explanation, participants selected 1 to 3 behavioural objectives that they actually wanted to work on.

Auto-recording system

By using pedometer with infrared wires commination transmitter system through the home gateway device (Tanita Co, Ltd, Tokyo, Japan), these data were uploaded and stored automatically on a web server. Therefore the patients and medical staff could monitor and share data of the number of daily steps and the weight on a web site (Figure 1b).[9]

Weight loss program

The weight loss program was conducted for 6 months using the HWS and auto-recording system. Tutorials were conducted at baseline and 3 months after the program. Patients received counselling from a doctor, dietitian, exercise therapist, or counsellor at baseline. At baseline, patients underwent chest radiography, pulse wave velocity examination, cardio pulmonary exercise test, electrocardiogram, abdominal computed tomography, blood test, anthropometry, and bioelectrical impedance analysis (BIA). Mail support was given once per week for 6 months, alternately by a dietitian and exercise therapist. They respectively gave advice with respect to the self-monitoring results of the behavioural objectives set at the initial interview, so as for about 80% of the behavioural objectives to be performed. In addition, for meals, specific meal contents were added to the advice based on the results of initial examination, according to the guidelines of each disease. With regard to exercise therapy, the subjects were advised how activity levels could be specifically increased using a pedometer as a reference. After 3 months, an interim appraisal was conducted during the dietitian's tutorial and new behavioural objectives were agreed.

Assessment

Energy and nutrient intake were estimated using the Food Frequency Questionnaire (FFQ) method based on food groups. Blood samples were taken after overnight fasting. Homeostasis model assessment insulin resistance (HOMA-IR), the indicator of insulin sensitivity, was calculated as follows: HOMA-IR = (fasting blood glucose × immunoreactive insulin)/405. Abdominal visceral fat area and subcutaneous fat area were calculated by abdominal computed tomography and visualized by using SomatomSensation16 (SIEMENS Co, Ltd, Erlangen, Germany). Body composition was analyzed using the InBody720 (BIOSPACE Co., Ltd., Tokyo, Japan) BIA method. Metabolic syndrome criteria number was assessed. The Japanese criteria are shown below: blood glucose category: fasting blood sugar ≥110 mg/dL, lipid metabolism category: high-density lipoprotein cholesterol <40 mg/dL or triglycerides ≥150 mg/dL, blood pressure (BP) category: systolic BP ≥130 mmHg or diastolic BP ≥85 mmHg

The weight loss ratio was calculated using the following formula: (body weight at intervention - body weight at the end of weight loss program) / body weight at intervention.

Statistical analysis

For descriptive analyses values were presented as number (percent) or mean±standard deviation (SD). For statistical analysis, Dr SPSS II for Windows, ver 11.0.1J (SPSS Japan Inc, Tokyo, Japan) was used. The Mann-Whitney *U* test, Wilcoxon signed-rank test, McNemar test, and χ^2 test were used for statistical analyses of the differences between groups. Spearman's correlation coefficient was calculated to determine correlations between 2 parameters. The Friedman test was used for statistical analysis of differences between multiple points. A p value of <0.05 was considered statistically significant.

RESULTS

Total assessment

Comparisons were made between baseline and post intervention. We excluded 3 women who could not be contacted through the web site and who had not come to the hospital for their interim appraisal. Because we lost the body composition data of 2 patients at the end of weight loss program, we assessed body composition data from 15 patients and other data from 17 patients. Body weight decreased significantly from the intervention versus at the end of intervention mean±SD=74.2±8.6 vs 72.2±8.8, p=0.047); body fat mass and body fat ratio also decreased significantly (p=0.013, p=0.006 respectively). BMI showed a tendency to decrease. Abdominal visceral fat area significantly decreased (p=0.017), but skeletal muscle mass was unchanged (Table 2). In biochemical test, we missed 1 patient data. Biochemical testing revealed that cholinesterase levels and alanine aminotransferase levels significantly improved (p=0.003, p=0.033 respectively). Immunoreactive insulin, HOMA-IR, uric acid, and aspartate aminotransferase levels showed a tendency to improve (Table 3). Metabolic syndrome criteria number showed a tendency to decrease (Table 4).

Food and nutrient intake status

The FFQ showed that energy, protein, fat, carbohydrate, cholesterol, sodium, monounsaturated fatty acid, and polyunsaturated fatty acid intake significantly decreased. Protein-energy intake ratio showed a tendency to increase, and fat-energy intake ratio showed a tendency to decrease (Table 5). Analysis of food groups showed that intake of fish and shellfish, confectionaries, and fats and oils as well as the energy intake from these categories significantly decreased. Vegetable intake, excluding intake of green and yellow vegetables, showed a tendency to increase (Table 6).

Table 2. Physical and physiological test data

	Baseline	Post	Difference (Post-baseline)	*p* value
Body weight (kg)	74.2±8.6	72.2±8.8	-2.0	0.047
BMI (kg/m^2)	28.7±2.0	27.9±2.7	-0.8	0.057
Skeletal muscle mass (kg)	25.5±4.9	25.6±4.8	+0.2	0.489
Body fat mass (kg)	28.3±3.6	25.9±4.9	-2.4	0.013
Body fat ratio (%)	38.4±4.9	36.0±6.0	-2.4	0.006
W/H	0.92±0.04	0.91±0.05	-0.01	0.100
VFA (cm^2)	122±41.9	109±40.2	-12.6	0.017
SFA (cm^2)	297±65.1	283±69.1	-13.4	0.352
SBP (mmHg)	115±17	110±11	-5	0.214
DBP (mmHg)	74±9	71±8	-3	0.204

Data are expressed as mean±SD. Wilcoxon signed-rank test was used for statistical analyses of the differences between two groups. BMI: body mass index; W/H: waist hip ratio; VFA: abdominal visceral fat area; SFA: abdominal subcutaneous fat area; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Table 3. Biochemical test data

	Baseline	Post	Difference (Post-baseline)	*p* value
FBS (mg/dL)	97±9	95±10	-2	0.223
HbA1c (JDS) (%)	5.4±0.5	5.3±0.4	-0.1	0.954
HbA1c (NGSP) (%)	5.8±0.5	5.7±0.4	-0.1	0.886
IRI (μu/mL)	11.7±5.7	10.0±5.0	-1.7	0.078
HOMA-IR	2.8±1.6	2.4±1.4	-0.4	0.070
UA (mg/dL)	5.3±0.7	5.0±0.7	-0.3	0.062
ChE (U/L)	383±67	350±40	-33	0.003
TG (mg/dL)	134±73	121±52	-13	0.356
HDL-C (mg/dL)	52±12	53±8	+1	0.717
LDL-C (mg/dL)	128±33	125±25	-3	0.420
Adiponectin (μg/mL)	5.1±2.7	4.8±2.8	-0.3	0.650
AST (IU/L)	23±11	20±9	-3	0.051
ALT (IU/L)	34±29	27±23	-7	0.033
Hs-CRP (mg/dL)	0.11±0.06	0.14±0.10	+0.03	0.463

Data are expressed as mean±SD. Wilcoxon signed-rank test was used for statistical analyses of the differences between two groups. FBS: fasting blood sugar; HbA1c (JDS): hemoglobin A1c (Japan Diabetes Society value); HbA1c (NGSP): hemoglobin A1c (National Glycohemoglobin Standardization Program value); IRI: immunoreactive insulin; HOMA-IR: homeostasis model assessment of insulin resistance; UA: uric acid; ChE: cholinesterase; TG: triglyceride; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; AST: aspartate aminotransferase; ALT: alanine aminotransferase; Hs-CRP: high sensitivity C reactive protein.

Table 4. Metabolic syndrome criteria number

Number	Baseline	Post	*p* value
0	6	11	0.083
1	8	4	
2	2	1	
3	0	0	

McNemar test was used for statistical analyses of the differences between two groups.

Weight loss ratio

Weight loss ratio 6 months showed a strong correlation with initial weight loss ratio (weight loss ratio at 1, 2, and 3 months: r=0.604, 0.618, and 0.552, respectively).

Steps taken

After 6 months, the average number of steps taken in each month did not change (data not shown).

Comparisons between the good weight loss group and the poor weight loss group

To investigate characteristics that may indicate suitability for this weight loss program, we divided patients into two groups according to their weight loss ratio: the good-weight loss group (weight loss ratio ≥5%, n=9) and the poor weight loss group (weight loss ratio <5%, n=6). We then compared the results of the baseline 40-item self-administered questionnaire responses to each question between the 2 groups. In the good weight loss group, many patients had behaviours that could result in obesity at the start of intervention. Significantly more number of patients in this group reported that they drank alcohol every day (p=0.001), did not eat sometimes (p=0.087), ate a midnight snack (p=0.082), ate the family's leftovers sometimes (p=0.063), and were not interested in doing sports (p=0.001) compared poor weight loss group. We also assessed the attainment of each behavioural objective, which indicates the percentages of evaluation "1: could" for each behavioural objective on days. There was no significant difference between the 2 groups in the attainment of each behavioural objective among 6 months (good weight loss vs. poor weight loss (mean±SD) =54.4%±22.4% vs. 47.4%±16.7%, p=0 .689).

DISCUSSION

We administered a weight loss program using a new IT

Table 5. Energy and nutrient intake

	Baseline	Post	Difference (Post-baseline)	*p* value
Energy (kcal)	2044±484	1765±396	-279	0.003
Protein (g)	73.0±20.5	65.6±18.6	-7.4	0.002
Fat (g)	73.0±22.1	59.4±16.7	-13.6	0.001
Carbohydrate (g)	267±62.6	234±49.2	-32.8	0.019
Saturated fatty acids (g)	24.2±8.75	19.4±7.15	-4.75	0.001
MUFA (g)	25.4±7.84	20.6±5.65	-4.89	0.001
PUFA (g)	13.9±3.99	11.8±2.91	-2.11	0.003
n-3 PUFA (g)	2.43±0.75	2.07±0.71	-0.36	0.001
n-6 PUFA (g)	11.4±3.30	9.65±2.25	-1.75	0.006
n-6/n-3	4.8±0.8	4.9±0.9	+0.1	0.382
Total fatty acid (g)	63.6±19.3	51.8±14.9	-11.78	0.001
Cholesterol (mg)	375±123	318±123	-57	0.003
Total dietary fibers (g)	13.8±4.1	13.4±3.3	-0.4	0.173
NaCl (g)	9.7±3.5	9.0±3.4	-0.7	0.009
Protein energy ratio (%)	14.2±1.7	14.8±1.7	+0.6	0.075
Fat energy ratio (%)	32.0±4.4	30.2±3.6	-1.8	0.075
Carbohydrate energy ratio (%)	53.8±5.1	55.1±4.8	+1.3	0.221

Data are expressed as mean±SD. Wilcoxon signed-rank test was used for statistical analyses of the differences between two groups. MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; n-6/n-3: n-6 fatty acid n-3 fatty acid ratio.

Table 6. Intake of food group and small classification (g)

18 food group	Small classification	Baseline	Post	Difference (Post-baseline)	*p* value
Cereals		362±77.6	359±89.2	-2.8	0.575
	Rice	254±78.9	238.1±88.5	-16.3	0.182
	Bread	35.6±22.9	41.2±27.5	-5.6	0.465
	Noodles	72.2±43.1	80.1±63.0	+7.9	0.442
Potatoes		31.3±24.8	33.0±28.4	+1.7	0.786
Green and yellow vegetables		83.0±43.7	92.0±46.3	+9.0	0.136
Other vegetables		140±69.1	156±71.7	16.5	0.116
	Other vegetables and Fungi	127±67.3	143±71.7	+16.3	0.078
	Pickled vegetables	10.7±11.4	10.7±11.4	±0.0	1.000
	Tsukudani	2.1±2.8	2.4±3.1	+0.3	1.000
Algae		5.2±3.8	4.6±3.4	-0.6	0.285
Pulses		59.2±42.0	60.8±40.7	+1.6	0.180
Fish and shellfish		65.8±30.9	56.7±32.8	-9.1	0.043
	Fish and shellfish (other small fish)	60.2±25.9	51.2±27.1	-9.0	0.068
	Small fish	5.6±6.9	5.5±7.0	-0.1	0.785
Meats		90.8±54.5	79.1±40.3	-11.7	0.176
Eggs		36.3±15.8	34.6±19.1	-1.7	0.655
Milk and dairy products		189±151	179±129	-9.8	0.753
	Milk	119±114	122±108	+3.8	0.785
	Dairy products	70.3±62.8	56.7±44.9	-13.6	0.225
Fruits		101±85.4	105±86.5	+3.3	0.854
Confectionaries		103±60.0	44.9±35.7	-58.0	0.002
Preference beverage		88.7±138	98.4±157	9.7	0.715
	Alcoholic beverages	9.9±20.7	26.4±82.6	+16.5	0.593
	Non alcoholic beverages	78.8±136	72.0±135	-6.8	0.593
Sugar		7.5±6.3	6.8±4.9	-0.7	1.000
Nuts and seeds		2.2±2.3	2.2±2.2	±0	0.655
Fats and oils		12.9±5.9	11.3±5.5	-1.6	0.042
Seasonings and spices		25.4±14.2	23.0±14.2	-2.4	0.128

Data are expressed as mean±SD. Wilcoxon signed-rank test was used for statistical analyses of the differences between two groups. Fungi category was expected.

system and low frequency face-to-face visits for pre-obese patients at the Health Science Centre of our university hospital. This weight loss program, which included only 2 face-to-face visits over 6 months, achieved a significant mean weight loss of 2.7%. The following 2 are considered to be the primary reasons. First, behavioural objectives were defined after investigating personality traits, behavioural traits, and the background of daily life in detail in the subjects at the initial interview. The subjects will select behaviours enhancing weight loss that they want to change or they think they can perform. We believe that this method realized a state where subjects

could achieve selected behavioural objectives without difficulty which resulted in weight loss, even though they were not interviewed over a long term. Second, as we could check the automatic recording device for body weight and walking steps daily and the degree of achievement of behavioural objectives selected by the subjects, they could look back on themselves while medical staff could provide mail support corresponding to latest conditions of individuals. The weight loss ratio in this study compared well with a weight loss intervention that included 4 personal interviews and group guidance over a 4-month period in subjects who had a BMI >25 kg/m^2, or who had >1 metabolic syndrome criteria. In that study, the mean weight loss was 3.2% in men and 2.9% in women.[10] In another study in which a dietitian performed 10 personal interviews over 9 months, in subjects with a mean BMI of 28.5 kg/m^2 and normal glucose tolerance and in subjects with a mean BMI of 30.6 kg/m^2 and impaired glucose tolerance, an average weight loss of 3.2% was achieved.[11] Another study that used gemfibrozil (a fibrate) and advice on food over 6 months in male volunteer subjects with a mean BMI of 30.9 kg/m^2 achieved an average weight loss of 1.5%.[12]

By extracting each patient's particular lifestyle problems and doable behavioural objectives accordingly, monitoring daily weight and number of steps taken using an automatic recording system, and providing mail support, our weight loss program achieved a level of weight loss that was similar to that in the studies described above, even with minimal face-to-face contact.

The goal in the treatment of obesity accompanied by metabolic disorder is 5% weight loss. We achieved a weight loss of 2.7%, based on body fat mass reduction (especially visceral fat reduction) and not on skeletal muscle mass changes. Metabolic syndrome is defined based on visceral fat accumulation. Visceral fat has been reported to secrete numerous inflammatory cytokines such as tumor necrosis factor-α, interleukin IL-6, and IL-1β that increase the risk of diseases such as cardiovascular disease,[13] non-alcoholic fatty liver disease, progressive-type non-alcoholic steatohepatitis,[14] type-2 diabetes mellitus,[3] and stroke.[5] Therefore, it is very important to lose visceral fat. We observed a significant reduction in the visceral fat area with this weight loss program, accompanied by improvement in several laboratory parameters and a tendency for decreased metabolic syndrome criteria number.

Food and nutrient intake improved during this program, and this was believed to be related to the observed improvements in laboratory parameters. However, fish and shellfish intake decreased unexpectedly. Fish intake has been reported to be related to the risk of type-2 diabetes mellitus[15] and stroke.[16] Fish, especially blueback, contains high levels of n-3 fatty acids, which have been reported to improve obesity-related disease.[17] Given this finding, it will be important to improve the quality of food intake, using an e-mail system or other intervention, when administering this program.

In this study, weight loss ratio after 6 months and the initial weight were strongly significantly correlated. This result indicates that this weight loss program may allow for the early estimation of the weight loss ratio that will be obtained by the end of the program; patients who do not achieve weight loss in the early phase of the program may need to reconsider their intervention method or reset their behavioural objectives. With regard to the results of the questionnaires of the two weight loss groups (groups achieving ≥5% and <5% weight loss), assuming that the behavioural traits of subjects at baseline might affect the effectiveness of weight loss, we compared the results of the behavioural trait test conducted at the initial interview between two groups. The results showed that, in the ≥5% achievement group, many patients conducted behaviours that could result in obesity at the start of intervention. At the start of intervention, there was room to correct behaviours that could result in obesity, which we believe resulted in the achievement of 5% or more. In contrast, there were not many behaviours resulting in obesity in the <5% group; we believe that the instruction by IT alone could not intervene with the behaviours that could result in obesity. The <5% group may require further innovative ideas or a method introduced with totally novel ideas. This indicates that lifestyle analysis at baseline may allow for the estimation of future weight loss.

In this study, the subjects achieved 2.7% significant weight loss. However, some limitations of the present study require consideration. Firstly, this study is a pilot study using this system. Therefore, it is considered necessary to examine the effectiveness of weight loss at multiple institutions by increasing the number of subjects in the future. Secondly, as the subjects in this study were those interested in weight loss, their motivation toward weight loss was high, which may have led to effective weight loss. Thirdly since we were unable to examine weight loss efficacy compared with control group in this study as the traditional face-to-face weight loss program, we need to collect some data from people who received the therapy as control group to make the result more convincing.

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AUTHOR DISCLOSURES

The authors have no conflicts of interest to declare.

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Original Article

Utility of a web-based weight loss program with auto-extraction of behavioural objectives and recording of daily weight and steps in pre-obese outpatients

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适用于肥胖前期门诊病人智能提取减肥目标和记录每日体重及具体实施步骤的网络减肥方案

目前，肥胖是世界上许多地方的一个重要的公共卫生问题。通过面对面地制定个性化生活方式来治疗肥胖是一个非常重要的方法。但是时间和人员的短缺导致此方法难以推广。我们制订了一套针对肥胖病人基于网络的减肥方案，此方案从 2010 年 7 月到 2012 年 1 月间开展，期间，6 个月内仅需要与病人会面两次。该方案使用一套可以智能提取减肥目标和智能记录每日体重以每日所采用的步骤。参与此方案的有 3 位肥胖男性（平均年龄：35.7±2.3 岁，平均身高体重指数（BMI）：30.4±0.8 kg/m^2）和 17 位肥胖女性（平均年龄：39.3±9.5 岁，平均 BMI：28.1±1.8 kg/m^2），均自愿参与此项方案。在此项方案实施中，体重明显减轻（平均下降 2.7%，p=0.047），腹部内脏脂肪面积（VFA）也有显著下降（平均下降 12.6%, p=0.017），血清胆碱酯酶和丙氨酸氨基转移酶升高明显（分别为 33 U/L，p=0.003; 7 IU/L, p=0.033）。代谢综合征指标也有所下降。有关食物频率问卷调查显示饮食和营养的摄入水平都有所提高。6 个月体重降低率和初始体重降低率显著相关。此项可以智能提取减肥目标和记录每天体重及具体实施步骤的网络减肥方案在节约人力资源的情况下，能够有效减轻体重、减少 VFA。

关键词：基于网络、减轻体重、减轻体重方案、腹部内脏脂肪面积、肥胖